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Fiscal Year 1964

Summary Report of

**UTILIZATION
RESEARCH
and
DEVELOPMENT**

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Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE
Washington, D.C. January 1965

CONGRESSIONAL DIRECTIVE

This report is submitted in further response to the request made by the Committee on Appropriations in its report to the Senate on the Agricultural and Farm Credit Administration Appropriation Bill, 1960 (Report No. 330). This request, on page 4, paragraph 3 of the report under section entitled "Utilization Research," states:

"Further, the committee specifically requests that it be kept advised by an annual summary report on research developments, including the work in progress at these laboratories, proposed new work, and on projects to be discontinued due to completion of work or lack of results with the reasons for discontinuance. It is the hope of the committee that it will be kept better advised not only as to the specific accomplishments in the field of utilization research but also as to fiscal requirements at these installations."

Previous reports concerning the utilization research activities of the Department, made in compliance with this request, have been submitted for Fiscal Years 1959, 1960, 1961, 1962 and 1963.

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UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service

SUMMARY REPORT OF UTILIZATION RESEARCH AND DEVELOPMENT

Fiscal Year 1964

I NATURE AND OPERATION OF UTILIZATION RESEARCH

Utilization research aimed at expansion of agricultural markets and reduction of processing and distribution costs can increase farm income and consumer's welfare, and can reduce excessive carry-over of farm commodities. To accomplish these objectives, the USDA utilization research and development efforts are directed to: (a) devising less costly, more attractive, and more nutritive convenience-in-use food products; (b) improving functional properties of natural fibers to better meet consumers' desires; (c) developing more economic and more nutritive processed feed products; and (d) seeking broadened industrial uses for agricultural materials.

The Department's utilization research investigations are conducted primarily in Federal facilities consisting of four regional laboratories and ten field stations in the United States. Research is done also through contracts and memoranda of understanding with State Experiment Stations, universities, and industry. Other supporting research is accomplished in research institutions of twenty countries in Europe, Asia, South America, and Australia, through funds generated by the P. L. 480 program (Agricultural Trade and Development and Assistance Act of 1954, 83rd Congress, 2nd Session).

II DISSEMINATING UTILIZATION RESEARCH INFORMATION

The basic and applied technical information resulting from the utilization research and development program is made available for public use by all available means. A substantial increase in the efforts to publicize these findings was evident in F. Y. 1964, particularly with increases in the number of research papers, speeches, and technical visitors to UR&D installations. In F. Y. 1964, these efforts may be summarized as follows:

- 52 patents obtained
- 791 research papers published
- 748 speeches, press releases, and appearances on radio and television
- 59 formal conferences with industry
- 23 public-service exhibits
- 7,100 technical visitors to UR&D installations

Rural Areas Development

The Utilization Research and Development participation in the Rural Areas Development program was greatly accelerated during F. Y. 1964. Two full-time industrial analysts -- specialists in the design, operation, cost analysis, and distribution and use of end-products -- worked directly with communities concerning agricultural processing possibilities in 12 states. By invitation, a total of 33 formal presentations were made to Federal, State and local groups outlining the specific assistance UR&D is in a position to give in agricultural processing; in many instances specific manufacturing plant proposals prepared by the communities were reviewed and suggestions made for providing more fruitful operations.

A general brochure describing the UR&D assistance was distributed to Federal, State and local representatives interested in agricultural processing. Drafts were prepared of several technical bulletins, each pertaining to manufacturing a specific type of agricultural product -- e.g., processed mixed feeds, maple sirup products, stabilized tree nuts, and dehydrated egg products -- which will be published in the near future.

Other supporting material for informing communities of UR&D know-how and assistance includes 6 color movies, some 400 color slides, and pilot-plant samples, that illustrate essential manufacturing operations and end uses of agricultural products believed to have potential for the rural areas development program.

Continuing liaison has been maintained with (a) USDA agencies concerned in the RAD program (Office of Rural Areas Development, Farmers Home Administration, Soil Conservation Service, Federal Extension Service, Rural Electrification Administration, Cooperative State Research Service); (b) State RAD Boards and Technical Action Panels in the States; (c) the Area Redevelopment Administration; and (d) the Small Business Administration.

Assistance on Proposed Agricultural Processing Plants:

In F. Y. 1964, UR&D assisted in the feasibility evaluation and plant planning for the following agricultural processing plants:

Fruit and vegetable products	14
Cereal grain products	2
Cotton, wool, and leather products	5
Processed feed products	7
Oilseed products	1
Sugar and maple sirup products	3
Egg products	1
Miscellaneous products	<u>2</u>
Total	35

Utilization Research Illustrative Materials

Four 16-mm. color-sound motion pictures were extensively used to demonstrate processing techniques and end-uses of UR&D-developed products and processes:

Title	Subject	Length (minutes)
"Drying by D-B-D Process"	A new fruit drying process (dry-blanch-dry)	13
"Potato Processing"	A new process for making dehydrated potato granules	15
"Foam-Mat Drying"	The new foam-mat process for dehydrating liquids and purees	11
"Current Engineering Projects"	General presentation of current engineering research projects	23

Typical examples of the special exhibits prepared and shown during F. Y. 1964 are:

Group Concerned	Subject	Location
National Restaurant Association and American Motor Hotel Association	New fruit juice powders, explosive puff-dried vegetables, and convenience-in-use cereal grain products	Chicago, Illinois
California Freezers Assoc.	Quality appraisal of commercially-packed frozen fruits and vegetables	San Francisco, Calif.
Northwest Cannery and Freezers Association	Quality appraisal of commercially-packed frozen fruits and vegetables	Seattle, Wash.
2nd Technical Wool Conference (Wool growers and processors)	Shrink- and muss-resistant treatment for wool fabrics and garments	San Francisco, Calif.
President's Consumers Conference	New cotton finishes (wash-wear, flame-resistant, stretch)	St. Louis, Missouri
International Trade Fair	New cotton finishes (wash-wear, flame-resistant, stretch)	Rio de Janiero, Brazil
International Textile Exhibit	New cotton finishes (wash-wear, flame-resistant, stretch)	Bombay, India

Formal Conferences with Industry and Other Outside Organizations

Of the 59 formal conferences held by UR&D laboratories with industry and other organizations, those cited below are typical of the kinds of groups and attendance:

Conference	Sponsors	Attendance	Location
Thirteenth National Potato Utilization Conference (July 15-17, 1963)	EU; United Fresh Fruit and Vegetable Assoc.; 8 other associations	350	Riverhead, New York
Meeting of Evaporated Milk Association Administrative Technologists (November 6, 1963)	EU; Evaporated Milk Association	24	Washington D. C.
Meeting of American Leather Chemists Assoc. (Research) (March 2-3, 1964)	EU; American Leather Chemists Association	17	Wyndmoor, Pa.
Meeting of Research and Technical Committee, Fatty Acid Producers' Council (Dec. 3, 1963)	NU; WU; SU; EU: Fatty Acid Producers Council	45	Peoria, Ill.
1964 Meeting, North Central Experiment Station Directors and Extension Service Directors (March 24-26, 1964)	NU; Agr. Experiment Station Directors; Agr. Extension Directors	45	Peoria, Ill.
Fifth Annual Corn Dry Milling Conference (June 9, 1964)	NU; American Corn Millers Federation	34	Peoria, Ill.
1964 Annual Joint Conference of Cooperative Soybean Oil Mills and Cooperative Cottonseed Oil Mills (June 29-30, 1964)	NU; SU; FCS; Coop. Soybean Oil Mills; Coop. Cottonseed Oil Mills	90	Winnipeg, Manitoba
Citrus Processing Conference (October 9, 1963)	SU; citrus industry	113	Winter Haven, Fla.
Cotton Batting Workshop (November 22, 1963)	SU; cotton industry	73	New Orleans, La.

Conference	Sponsors	Attendance	Location
Southern Agricultural Experiment Stations Meeting (March 16-17, 1964)	SU; Southern Agricultural Experiment Stations	31	New Orleans, La.
National Peanut Council Convention (April 6, 1964)	SU: National Peanut Council	97	New Orleans, La.
4th Cotton Utilization Research Conference (April 30 - May 1, 1964)	SU; cotton industry	250	New Orleans, La.
Bulgur (dried wheat) for Texas School Lunch Program (Aug. 5-9, 1963)	WU; Texas State Dept. of Education	130	Austin, Texas
Second National Conference on Wheat Utilization (October 28-30, 1963)	WU; NU; other USDA; Natl. Assoc. Wheat Growers; Great Plains Wheat; Western Wheat Assoc.	195	Peoria, Ill.
California Home Economics Society (bulgur and dried fruit) (November 2, 1963)	WU; Calif. Home Economics Society	120	Albany, Cal.
Annual Meeting Northwest Cannery & Freezers Assoc. (January 12, 1964)	WU; Northwest Cannery and Freezers Assoc.	150	Seattle, Wash.
California Freezers Assoc. Meeting (February 12-14, 1964)	WU; AMS; Univ. of Cal.; Cal. Freezers Assoc.	400	San Francisco, Cal.
Technical Wool Conference (May 10-13, 1964)	WU; wool industry	180	San Francisco, Cal.
Dried Fruit Research Conference (June 12-13, 1964)	WU; Dried Fruit Assoc.; Univ. of Cal.	100	Monterey, Cal.

III COOPERATIVE RESEARCH WITH OTHER ORGANIZATIONS

Whenever practical, the assistance of other groups is sought to help develop new products, economic processes for product manufacture, and outlets for the new products. Such cooperative efforts shorten the time of achievement and accelerate commercialization considerations. Examples of cooperative research and development are:

Project	Cooperators with USDA UR&D
Development of Crambe as a new crop	Nebraska Agr. Exp. Station; commercial oilseed processors
Linseed oil emulsions for curing and protecting concrete	Kansas State Univ.; Natl. Flaxseed Processors Association
Degermination studies related to corn dry milling	American Corn Millers Federation
New and improved cotton batting products (e.g., headliners, bucket seats, crash pads, etc.)	Natl. Cotton Batting Institute; Textile Waste Assoc.; National Cottonseed Prod. Assoc.; Found. for Cotton Research & Education
Commercialization of ion-exchange process for purification of melted raw sugars	Puerto Rico Agr. Exp. Station; Ponce Candy Industries, Inc. (Puerto Rico)
New and improved cotton products for U. S. armed services	U. S. Army Natick Laboratories
Fractionation of alfalfa meal to provide feeds for specific end uses	Dept. of Agr. and Inspection, State of Nebraska; commercial alfalfa dehydration plants
Research to improve texture in frozen vegetables	National Association of Frozen Food Packers
Improved utilization of animal protein residues	National Renderers Association
Development of process for removal of radionuclides from milk	U. S. Atomic Energy Commission; U. S. Public Health Service; Milk Producers Cooperative
Market evaluation of new products developed by UR&D	Economic Research Service, USDA

IV PROGRAM MODIFICATION TO MEET CHANGING NEEDS

Planning and Advisory Activities

The U. S. Department of Agriculture program to find new and better ways to utilize farm products is based on extensive planning, continuous reviewing of results, and modification of these many efforts to reflect current objectives. These program activities take advantage of the findings and cooperation of many organizations and individuals both within and outside the Department of Agriculture.

The Deputy Administrator, Administrative Staff, and Division Directors of Nutrition, Consumer and Industrial Use Research are responsible for policy and planning. The Product and Process Evaluation Staff, composed of professional specialists, assists this administrative group in evaluating the commercial feasibility and general appropriateness of proposed and existing utilization research projects. In addition to the many contacts both within and outside the Department, special consultants, authorities in particular fields, assist in evaluating research and development activities.

Committee on Agricultural Science. An advisory group of nationally recognized professional personnel, including representatives of state universities and experiment stations, that reviews, evaluates, and makes recommendations concerning USDA research in related basic sciences.

USDA National Agricultural Research Advisory Committee. An advisory committee, with broad national interests in all phases of agriculture, that evaluates the Department's entire research program and offers suggestions, particularly on policy matters, for modifications, additions, and deletions in the USDA program.

National Advisory Committee on Rural Areas Development. An advisory committee representing agricultural industries, farmers, educational institutions, finance groups and regional representatives, that makes suggestions for the greater development of rural areas.

Commodity and Functional Advisory Committees. The 13 Commodity and Functional Advisory Committees -- authorized under the Research and Marketing Act of 1946 -- offer suggestions on present work and on needed future direction of research, and assure more effective communication with the many organizations interested in agricultural research:

- Farm Resources and Facilities Research
- Utilization Research and Development
- Human Nutrition and Consumer Use Research
- Marketing Research
- Agricultural Economics Research
- Forestry Research
- Animal and Animal Products Research
- Tobacco Research
- Cotton Research

Grain and Forage Crops Research
Horticultural Crops Research
Oilseed, Peanut and Sugar Crops Research
Plant Science and Entomology Research

State Agricultural Experiment Stations. The Directors and designated technical collaborators of the State Agricultural Experiment Stations, in the respective four national regions, that assist in planning research activities of mutual interest to the Federal and State groups.

Agricultural Associations and Industry Groups. Advice is sought, and technical and related information exchanged, from all segments of the agricultural industry -- growers, shippers, processors, and distributors -- concerning the many problems of profitably converting agricultural commodities to newer and broader uses.

Consumer Interests. Consumer desires for new and improved products, as well as evaluation of newly developed items, are sought through contacts with consumer groups of national and regional scope. Other USDA groups give assistance in consumer needs and market trends -- Economic Research Service, Federal Extension Service, and market and consumer use research groups in ARS.

Program Dynamics

The Utilization Research and Development program is continuously appraised and reviewed (1) to determine fruitfulness of the research efforts, (2) to discontinue investigations that have reached the point of optimum return or appear unrewarding of useful results, and (3) to direct new or to intensify existing research efforts to meet new needs either by reduction of effort on projects of lesser importance or by new resources that may be available.

Typical examples of redirected research efforts are given in the following chart:

Research Terminated or Redirected	Research Initiated or Expanded (Made possible by the research terminated or redirected)
Process development for imparting water repellency to chrome leather	Chemical modification of hides with aldehydes and urea derivatives
Development of satisfactory treatments to minimize effects of acid and alkali on wool	Development of wool fibers with permanent high-luster
Processing quality of Concord-type grapes	Chemistry of phenolic pigments in fruits and of their changes during processing
Studies of chemical changes chloro- phyll undergoes in vegetable processing	Effects of processing on texture of frozen vegetables
Reduction of efforts on development of milling methods to produce wheat products for industrial use	Development of milling methods to minimize radioactive contamination of wheat products for human con- sumption and for livestock and poultry feeds
Certain basic studies on soybean proteins redirected	Accelerated development of new pro- tein products with gelling and foaming properties
Completion of basic studies on formu- lation and stability of linseed oil emulsions	Studies on the use of linseed oil emulsions as a curing and anti- spalling agent for concrete (especially for highway use)
Studies of minor constituents of peanuts	Expansion of higher priority research on mold toxins of peanuts and other oilseeds
Development of processing procedures to minimize detrimental effects of short fibers in cotton	Development of optimum blending procedures for maximum utilization of cottons varying widely in fiber properties

Utilization Research Projects Terminated in F. Y. 1964

A total of 103 domestic research projects were terminated in F. Y. 1964 for the following reasons:

Research objectives attained	59
Research objectives partially attained	22
Research results unpromising or superseded by research of higher priority	10
Exploratory research to guide future work	12
Total terminated	103

In F. Y. 1964, 26 foreign research projects (under P. L. 480) were completed -- Israel (4); Japan (1); Finland (2); France (1); Italy (4); Spain (1); United Kingdom (13).

Utilization Research Projects Initiated or Revised in F. Y. 1964

One hundred ninety-one utilization research projects were initiated or revised in F. Y. 1964 -- 154 domestic and 37 foreign projects. A part of this increased number was for initiating or expanding work authorized by the \$5 million F. Y. 1964 increase.

COMMODITY	INDUSTRIAL USES		FOOD USES		FEED USES		TOTAL	
	<u>Dom.</u> ^{1/}	<u>For.</u> ^{2/}	<u>Dom.</u>	<u>For.</u>	<u>Dom.</u>	<u>For.</u>	<u>Dom.</u>	<u>For.</u>
Cereal grains and forages ..	23	5	7	3	5	2	35	10
Cotton and wool	39	12	--	--	--	--	39	12
Fruits and vegetables	--	--	25	3	--	--	25	3
Oilseeds	11	--	7	--	3	2	21	2
New and special crops	5	2	4	--	--	--	9	2
Poultry, dairy and animal products	7	4	18	4	--	--	25	8
	85	23	61	10	8	4	154	37

^{1/} Domestic

^{2/} Foreign

Summary of Utilization Research Projects for F. Y. 1964

Type	Active at Beginning F. Y. 1964	Initiated or Revised	Terminated	Active at end F. Y. 1964
Domestic	368	154	103	419*
Foreign	141	37	26	152
Total	509	191	129	571

* Includes 30 projects directly supported by industry (fellowships and direct finance support), 171 domestic contract projects, and 4 projects supported by funds transferred from other Federal Agencies.

New Research Initiated with Increased Appropriations

Additional research was made possible by an increase of \$5,000,000 in CCC-transferred funds in F. Y. 1964.

Cereals and Forage Crops

Two grants were made to a university (1) to study the organic chemistry of sulfur derivatives of starch, and (2) to explore the reaction of selected petrochemicals with starch to produce new products.

Research on grafting petrochemicals to starches was expanded by a contract with a research institution to prepare quantities of these new products for evaluation studies.

Research efforts on cereal xanthates were expanded by a research institute contract to study the preparation of wheat bran and ground whole wheat xanthates for use in making bag and box papers.

Contract investigations are being conducted by an industrial laboratory on the preparation and evaluation of starch plastic foams for industrial applications.

Research was expanded by a research institution contract to develop a fermentation process for making a beta-carotene product, by the NU fermentation method, sufficiently stable for use as a feed additive.

Investigations on the use of liquid nitrogen to preserve certain microorganisms that cannot be stored by present methods for use in industrial fermentations are being carried out under a contract.

In order to produce light-colored whole kernel wheat food products, contract studies have been initiated to determine the chemical nature of the pigments of wheat bran and aleurone.

Increased effort is being expended, under a research contract, to determine the factors which govern the amount of soft wheat which can be mixed with hard wheat without detrimental effects on the baking quality of the resulting flour.

The development of diverse new products from wheat is being facilitated by new studies (under contract) of the changes which occur in the protein and the other major nutrients of wheat during malting processes.

A new study has been started, through a grant, to identify the major oxidation-reduction enzyme system in wheat flour to obtain needed information on the "oxidative improvement" of U. S. Western wheats.

The production of high-quality feedstuff supplements from forage crops grown in the Southeastern States is being examined in recently initiated contract research work.

Cotton, Wool, and Other Fibers

Investigations have been expanded, by contract, to determine the effects of fiber extensibility on fiber breakage in mechanical processing.

Optimum yarn constructions, knitting structures, and prefabrication design for producing stretchable articles of knitted cotton wearing apparel by slack mercerization, are being investigated under contract.

Studies are being made, by contract, of the relationship of molecular size, nature, shape, conformation, and configuration of organic nonaqueous compounds to their swelling power on cotton cellulose.

Investigation, under a research contract, is being made of the chemical modification of cotton through treatments with reagents in the vapor phase.

Under contract research, a method is being developed for counting neps in cotton at various stages of textile processing.

Contract investigation of the physics of seam pucker in relation to fabric structure is directed to develop improved sewing thread for wash-wear cotton products.

Development of weather resistant cotton textiles with improved physical properties by interfacial and graft polymerization is being sought through a research contract.

Grant studies are being made to determine the correlation of surface microtopography of treated and untreated cotton fibers with resistance to soiling of cotton textiles.

An exploratory study of the crosslinking of chemically modified cotton to obtain cotton fabrics with an optimum combination of resiliency and thermoplasticity is being financed through a research grant.

The configurational interactions between fibers and yarns in the region of local deformations in woven cotton cloth are the subject of a grant-supported investigation.

Fruits and Vegetables

Work has been initiated, by contract, to improve viniferous grape products by developing more efficient procedures for extracting juice from grapes and for rapid extraction of color and aroma materials.

Several groups of chemical compounds present in apples and thought to cause cloudiness are being examined, under contract research, to provide a basis for the more efficient production of a clarified apple juice.

WU-developed processes for making "instant" powders from dry beans, peas, lentils, and other legumes are being developed into continuous, commercial-scale processes through contract research.

Fundamental studies have been increased, under a grant, to determine the factors which influence the sporulation of food spoilage bacteria in order to improve the quality of canned vegetables and other low-acid foods.

Work through a research contract is determining the composition of flavor components of peaches (with emphasis on existing commercial varieties in the Southeastern U. S.).

Development of a practical and efficient pilot plant process for the manufacture of enzymatically debittered grapefruit juice and products with improved flavor, product stability, and storage characteristics is sought through a research contract.

Oilseeds

The relation of the carbohydrate, amino acid, and protein components of peanuts to the formation of flavor and aroma during roasting are being investigated under a contract to aid in expanding the direct utilization of this commodity.

Development of processing methods are being undertaken, through contract research, using peanuts of known history with respect to different growing, harvesting and curing conditions, to provide processed peanut products of high quality and free of mycotoxins.

A research contract is directed to the development of practical processing methods for inactivation of cyclopropene groups in cottonseed meal that decrease its value as a feed for laying hens.

Research on the industrial use of soybean oil was expanded by a contract to evaluate new polymers for use as resins and adhesives.

Basic studies on the preparation and properties of new polymers from linseed oil were expanded under a contract with a research institute.

New and Special Plants

Research directed toward developing industrial uses for crambe, a promising new crop, was expanded by a contract with a research institute to prepare and evaluate new polymers from crambe oil for use in synthetic fibers and plastics.

Chemical investigations of the neutral resins of cured tobacco leaf and their contribution to cigarette smoke flavor and aroma have been expanded by a research contract.

Poultry, Dairy, and Animal Products

A study of the heat- and moisture-transfer characteristics of poultry meat has been initiated (by contract) to develop engineering information applicable to freeze-drying of piece-size poultry meat products.

Promising processes for pasteurizing eggs are being further appraised, through a research contract, for their effects on egg proteins, lipids, vitamins, and other components.

Basic studies were initiated, under a research grant, on physical changes occurring in milk and milk concentrates as a result of steam injection in high temperature - short time processes of sterilization of these products.

Research was begun, under a research grant, to obtain basic information on butter flavor for the purpose of improving the quality, especially the flavor characteristics, of butter and thus enhance its use as a flavor producing ingredient in food manufacturing.

An investigation of the relation of milk fat content and composition and of milk protein content to the dietary regimen of the dairy cow has been started under a research contract.

New basic knowledge regarding smoked meat is being applied, under a research contract, to the development of new smoked meat products.

Research has been expanded, through a grant, on the physical properties of collagen to obtain basic information for use in developing new products.

Fundamental investigations were begun, under a grant, on the ozonization of animal fats and derivatives thereof.

Development of new frozen meat products and determination of their time - temperature - tolerance relationships was begun under contract research.

Chemical and microbiological factors involved in the freezing of meat, particularly the relationship of the amounts and ratios of heme pigments to oxidative rancidity, are being studied under a grant for basic research.

V CURRENT UTILIZATION RESEARCH PROGRAM

The USDA utilization research and development program is a balanced effort of basic and applied research at present principally devoted to the following areas:

Cereal Grains and Forages. Emphasis on development of new uses for corn and wheat, with continuing investigations on rice, barley, oats, sorghum, and alfalfa and other legume and grass forages:

New wheat food products -- such as light-colored, quick-cooking bulgur, cereal "milks" for dietary deficient regions, high-protein rice products -- directed to meet needs of foreign consumers as well as desires of domestic users.

Basic studies of chemical groupings in wheat gluten as related to visco-elastic and gelling properties of wheat flours.

Industrial products from cereal grains, especially derivatives for manufacturing insulating foams, polymeric products for plastics, cereal "pulp" and other products for paper-making, industrially important organic acids, and microbial insecticides.

Use of dialdehyde starch derivatives to improve plywood adhesives, especially to meet the needs of the rapidly expanding Southern pine plywood industry.

Improved feed products through methods for controlling deleterious materials (e.g., saponins) and for increasing desired constituents (e.g., carotene and xanthophyll).

Cotton and Wool. New functional properties imparted to cotton and wool through chemical, physical, and mechanical processing research and development, supported by comprehensive fundamental studies of fiber properties and modification:

Continued development of new wash-wear processes, particularly to improve luster and strength properties.

Development of processes to impart stretch properties to cotton and wool (yarn and fabrics) to offset inroads of synthetic fibers in "stretch" items.

New water- and oil-resistant cotton finishes based on fluorochemicals; improved soil-resistant treatments for wash-wear cottons; more efficient methods for applying the SU-developed durable flame retardant finish, THPC, now being widely commercialized; better methods for short fiber utilization.

Development of more economical chemicals and techniques for the WU-developed WURLAN process now commercially applied to both wool fabric and wool top to give durable easy-care properties.

Fruits and Vegetables. Development of convenience-in-use fruit and vegetable products, and processing equipment for their economic manufacture, augmented by fundamental investigations on factors affecting color, texture, and flavor:

Adaption of the WU-developed foam-mat drying process for commercial production of grapefruit, orange, and other citrus juice powders.

Equipment design and process development to broaden the uses for the new EU explosive puff-drying process, now being commercialized for dehydrated carrots, for other fruit and vegetable products.

Basic engineering studies to improve product quality and to reduce cost in freeze-drying of fruits and vegetable products.

Continued development work on the new WU dry-blanch-dry process for improved texture, color, and flavor of dried fruit products.

Commercial adaptation of the SU process for producing dehydrated sweet-potato flakes.

Oilseeds. Principal research on soybean, cottonseed, and linseed oils, meals, and related products, with increasing efforts on castor, safflower, and selected oilseeds resulting from the new crops screening program:

Improved methods for producing the industrially useful aldehyde oils and related products from soybean and linseed oils; continued investigations to expand use of linseed oil derivatives in protecting concrete from erosion, weather, and chemical actions.

Commercial processing evaluation of Crambe, a promising new oilseed for industrial derivatives not supplied by presently grown domestic oilseeds.

Basic studies to improve flavor stability of soybean and other edible vegetable oils; investigation of flavor, nutritional, and flatulence factors of soybean meal for feed purposes.

Studies of halphen acid constituents and solvent extraction procedures to improve nutritional quality of cottonseed meal.

Evaluation of oil and meal products of new varieties of safflower oilseed directed to decreasing hull content and reducing processing costs.

Basic studies for identifying and controlling fungi and fungal metabolites in peanuts and peanut products as related to the possible incidence of aflatoxin.

New derivatives of castor oil for making fire retardant polyurethane foams; improved processing techniques for deallergenation of castorseed and pomace.

Development of intumescent fire-retardant protective coatings based on chemically-modified tung oil products.

New and Special Plants. Investigations directed to develop compositional data on plants from world-wide sources in an effort to find alternate crops to fill needs not now met by domestic sources, and to develop new and more economic uses for domestic special plants:

Research on industrial utilization of new oilseeds, particularly on processing of erucic, epoxy, petroselinic, and hydroxyconjugated dienoic acid oils, and the development of chemical derivatives from these sources; process to improve flavor and nutrient properties of Crambe meal for feed purposes.

Research on new pulping fiber plants, particularly sorghums, suitable for use in paper and related products.

Improvement of techniques for the processing of sugarcane and sugarbeets, and for manufacturing maple sirup and sorghum sirup; improved honey products; microbial production of organic acids from sugar; improvement of the ARS 15-thousand microorganism collection used for commercial manufacture of antibiotics and other pharmaceuticals, insecticides, and industrial products.

Development of new industrial chemicals from pine gum, turpentine, and rosin.

Chemical composition studies of tobacco and tobacco smoke to assist industry in its search for desired qualities in tobacco products.

Poultry, Dairy and Animal Products. Development of better and more economic food products from poultry, eggs, meat and milk, and development of new industrial outlets for fats, hides, and other animal byproducts:

New feather removal techniques and studies of post-mortem factors directed to improve tenderness of poultry meat; investigations to develop economically competitive freeze-drying processes for poultry meat products.

Commercial evaluation of gas-injection spray-drying of eggs; processes for improved control of Salmonella in egg products.

Improved meat products and better processing methods based upon fundamental studies of flavor, tenderness, microbiological activity, and time-temperature-tolerance stability.

New and improved milk products through studies of flavor stability; new concentrated and dried milk products (both whole milk and non-fat milk); commercial processes for removal of radionuclides from milk products; and improved cheese-making technology.

New uses for animal fats in specialty synthetic detergents with emphasis on development of biodegradable products; in industrial chemical intermediates; and in polymers, plastics, resins, and lubricants.

Development of new processes for imparting water resistance to leather; new and improved leather tanning procedures; and ways to better utilize protein fractions of meat and bone wastes in feed meals.

VI FINANCIAL INFORMATION

The F. Y. 1964 and F. Y. 1965 domestic utilization research and development funds under "Salaries and Expenses, Agricultural Research Service," including allotments from the Special Fund for additional labor, are as follows:

	F. Y. 1964 (Obligations)	F. Y. 1965 (Estimated)
Cereal and forage crops	\$ 5,289,291	\$ 5,557,700
Cotton, wool and other fibers	4,876,495	5,238,400
Fruits and vegetables	3,693,710	3,781,200
Oilseeds	3,194,746	3,190,400
New and special plants	2,062,805	2,075,100
Poultry, dairy, and animal products	<u>5,399,400</u>	<u>5,615,800</u>
Total	<u>\$24,516,447</u>	<u>\$25,458,600^{a/}</u>

^{a/} Excludes amounts needed to meet additional pay costs pursuant to Public Law 88-426 and wage board increases estimated at \$750,900.

In F. Y. 1964 Congress provided an increase of \$200,000 for peanut quality research for the Southern Utilization Research and Development Division, New Orleans, Louisiana. Obligations against this increase are included above.

In addition to the above funds, there were obligations, under a nonrecurring allocation from the Contingency Research Fund, of \$64,775 primarily to provide special equipment to expedite investigations of the occurrence, origin, detection and control of toxic or other deleterious materials in cottonseed and peanuts and other derived products.

The 1964 Appropriation Act also authorized use of the following funds:

1. CCC fund transfers authorized for

a. Expanded utilization research -- \$5,000,000:

	<u>Obligations under F.Y. 1964 Transfer</u>		
	<u>Research</u>		
	<u>Contracts and</u>	<u>Other</u>	<u>Total</u>
	<u>Grants</u>		
Cereals for industrial			
uses	\$ 770,695	\$ 227,000	\$ 997,695
Cereals for food uses	353,141	132,550	485,691
Forage	<u>91,938</u>	<u>8,140</u>	<u>100,078</u>
Subtotal, Cereal and			
forage crops	1,215,774	367,690	1,583,464

Obligations under F. Y. 1964
Transfer -- continued

	Research Contracts and Grants	Other	Total
Cotton	\$ 876,430	\$ 125,769	\$ 1,002,199
Subtotal, Cotton, wool and other fibers	876,430	125,769	1,002,199
Fruits and vegetables ...	414,195	43,229	457,424
Subtotal, Fruits and vegetables	414,195	43,229	457,424
Soybeans	202,630	--	202,630
Cottonseed	144,969	50,659	195,628
Linseed oil	49,250	--	49,250
Subtotal, Oilseeds	396,849	50,659	447,508
Naval stores	50,000	--	50,000
New crops	50,000	--	50,000
Tobacco	160,512	41,827	202,339
Subtotal, New and special plants	260,512	41,827	302,339
Poultry and eggs	166,846	39,400	206,246
Dairy products	307,675	97,813	405,488
Meat	322,764	48,561	371,325
Animal fats	79,524	20,700	100,224
Hides	88,952	11,402	100,354
Subtotal, Poultry, dairy, and animal products	965,761	217,876	1,183,637
Total expanded utili- zation research under CCC transfer	\$ 4,129,521	\$ 847,050	\$ 4,976,571

b. Construction of utilization research and development facilities -- \$9,750,000:

<u>Amount Authorized</u>	<u>Remarks</u>
California, Albany \$ 1,500,000	Architect-engineering contract awarded in October 1964. Construction of facility expected to be completed by March 1967.
Florida, Olustee 250,000	Architect-engineering contract awarded in July 1964. Intermediate drawings reviewed and returned to architect-engineer. Estimated completion of construction of facility by February 1966.
Illinois, Peoria 4,500,000	Architect-engineering contract awarded in July 1964. Diagrammatic drawings received from architect being reviewed. Completion of construction of facility estimated for March 1967.
Louisiana, New Orleans 1,500,000	Architect-engineering contract awarded in July 1964. Estimated completion of construction of facility by March 1967.
Pennsylvania, Wyndmoor 1,500,000	Architect-engineering contract awarded in July 1964. Diagrammatic drawings being revised. Estimated completion of facility by December 1966.
Texas, Weslaco 250,000	Architect-engineering contract awarded in September 1964. Intermediate drawings being reviewed. Estimated completion of facility by February 1966.

Survey, determination
of need, and planning
of additional research
facilities as may be
required for utiliza-
tion research in the
Southeast and weed con-
trol research, not to
exceed 250,000

See item under Section
32 funds below.

The principal portion of
this is available for
the Southeast utiliza-
tion research and devel-
opment laboratory.

Total UR&D Construction \$9,750,000

2. Section 32 fund transfers authorized for:

Georgia, Athens
Construction of Southeast
utilization research and
development laboratory \$9,500,000

Architect-engineering
contract awarded in July
1964. Diagrammatic
drawings received from
architect being reviewed.
Estimated completion of
construction of facility
by December 1967.

As indicated above, the total obligations in F. Y. 1964 for domestic utiliza-
tion research and development, exclusive of construction, were \$29,557,793.

In addition to the domestic program, the equivalent of approximately \$2.61
million in foreign currencies was obligated in F. Y. 1964 for utilization
research projects (largely extending over a five-year period) conducted under
agreements with foreign institutions. This work is financed by funds generated
under the P. L. 480 program.

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The 1965 Appropriation Act also provided for the transfer of Section 32 funds for the following research:

1. Utilization research and development (Part of a total authorization of \$5,000,000 for research on expanded use of agricultural commodities).

Research on mold problem (mycotoxins, including aflatoxins) of peanuts, other oilseeds and cereals ...	\$ 350,000
Research to identify health-related constituents of tobacco	200,000
Development of new and improved industrial products from cereals	650,000
Development of new and improved cotton textiles, research on cycloprene acids in cottonseed	500,000
Development of new dehydrated and frozen milk, meat, poultry and egg products, new and improved industrial uses for animal fats and hides, wool and mohair	500,000
Development of new and improved industrial products from soybeans, flaxseed, peanuts, castor and safflower	300,000
Research on horticultural crops, including citrus, grapes, and other fruit and vegetable products	500,000
Research on processing of sugar sorghum and forage crops	<u>100,000</u>
Sub-total	\$ 3,100,000
 2. Part of an authorization of \$1,500,000 for research in Kentucky on health-related problems of tobacco 900,000
- | | |
|----------------------------------------------------------------------------------------|---------------------|
| Total utilization research and development provided under Section 32 funds, 1965 | <u>\$ 4,000,000</u> |
|----------------------------------------------------------------------------------------|---------------------|

The total estimated obligations in F. Y. 1965 for domestic utilization research and development -- Salaries & Expenses and Section 32 Funds -- are \$29,458,600.

VII SELECTED RESEARCH ACCOMPLISHMENTS

New Light-Colored Bulgur. A bland, light-colored bulgur product, low in fiber and in cost, has been developed for use in certain world markets where the darker color of regular bulgur hinders establishment of commercial markets. Complete removal of colored bran layers from cooked hard red winter wheats by an inexpensive lye-peeling technique permits retention of good nutritive properties without staining of inner parts of the kernel by the bran pigments. In either whole kernel or cracked form, the new product is quick cooking and suitable for both the domestic convenience-in-use market and the expanding export markets. Conversion of present bulgur processes to make the new product is neither difficult nor expensive; added costs are estimated at less than one-half cent per pound. Bulgur production costs now run about 5.5¢ per pound. In the past 3 years export shipments have increased from about 60 million pounds to more than 360 million pounds per year, and this new product provides another entry into large potential new markets for U. S. wheats.

New Fermentation Process Developed for Production of 2-Ketogluconic Acid from Corn Sugar. The Department has discovered and developed an improved process for manufacturing from corn sugar the industrial chemical, 2-ketogluconic acid. Yields are higher and less time is required for the new procedure than by previous processes. A number of companies have made inquiry about the new process and several have requested cultures for making pilot runs. Several million pounds of 2-ketogluconic acid are used annually in the production of isoascorbic acid, a material used as an antioxidant in the preparation of various food products including meat. This more efficient method for making the 2-ketogluconic acid will assure still greater usage of this cereal-derived product.

Dialdehyde Starch Improves Plywood Glues. The Department's research has produced a superior glue for interior grade plywood for the developing southern pine plywood industry in which the conventional soyflour-based protein-type glues used in douglas fir plywood have proven unsatisfactory. The douglas fir plywood industry, which in the past supplied almost all of the softwood plywood, consumed over 150 million pounds of protein glues in 1963. The softwood plywood production has been increasing about 10 percent per year and future growth will probably come largely from southern pine. The first commercial production of southern pine plywood was in 1963. Addition of the Department-developed dialdehyde starch to conventional protein glues has given good performance with southern pine interior plywoods at about one-half the cost of synthetic glues that have been used to date.

Improved Procedure Discovered for Grafting Acrylonitrile to Starch. By an improved procedure devised by scientists at Stanford Research Institute under contract to the Department, acrylonitrile can be grafted rapidly to corn starch to give new physical and chemical properties to the starch. These acrylonitrile-starch graft copolymers can be converted readily to water-soluble products having potential as internal sizing agents and pigment retention aids for paper, drilling mud additives, and industrial adhesives. Graft polymerization is a promising new route to chemical modification of starch and development of starch-based products that can maintain competitive status and expand utilization of this agricultural product in today's market.

Pretempering Improves Processing of Old or Low-Moisture Corn. Department research has confirmed beneficial effects of pretempering in dry milling of old or low-moisture corn. In the pretempering step, which requires from 10 to 20 hours, moisture in the corn is brought up to a level of about 15½ percent. The pretempered corn is further tempered and then milled by conventional procedures. Compared to the results obtained when the corn is tempered to the final moisture in one step, both total yield of grits for manufacture of prime goods and yield of flaking grits are increased. Recovery of oil is not significantly altered. The principal disadvantage is that degerminator throughput is decreased. Several corn dry millers are using pretempering and find that it is an inexpensive means of overcoming difficulties encountered with corn that has been stored for long periods.

Separation of Dehydrated Forages into High and Low Fiber Fractions. Department scientists carrying out research cooperatively with the Nebraska State Department of Agriculture have developed methods for the dry separation of dehydrated forages into two products. One of these is high in protein, low in fiber, and particularly suited to the dietary requirements of poultry and swine. The other product contains relatively less protein and more fiber, and is better suited for ruminant use. By appropriate adjustments, intermediate products can be obtained to meet specific market needs. This development opens another avenue to tailor-made feeds to fit specific animal requirements and has excited broad industrial interest. Although evaluation studies are still incomplete, one company has already installed large-scale test equipment to convert part of their 1964 production to dual products. Other dehydrators have expressed enthusiasm for the system, and one concern is reported to be building a new plant which will emphasize dual product production.

SRRL Fiber Retriever Enthusiastically Accepted by the Cotton Textile Industry. The SRRL Fiber Retriever -- a simple, inexpensive Department-developed device that increases a carding machine's efficiency in removing trash from cotton to be spun -- is being widely utilized in the cotton textile industry. Released to industry in the Spring of 1963, the device is now being manufactured by 6 companies, and 15 companies have applied for licenses to manufacture it. Over 2,000 units are estimated to be in use and sales are reported to be increasing rapidly. Industry reports that the Fiber Retriever is essential for high production carding; and high production carding is a "must" for the cotton industry to compete with the processing of synthetics. The Fiber Retriever increases cleaning efficiency at the cleaning section of the card as much as 40 percent and overall cleaning efficiency of the card as much as 12 percent. High speed production has no adverse effect on the Retriever's performance. In addition to its efficient removal of trash, the device removes a high percentage of short fibers, decreases loss of spinnable fibers, and decreases damage to the fibers. As a result, there are improvements in yarn strength and uniformity. Through use of the new device, processing costs are lowered and maintenance requirements for the card are decreased.

Utilization of Cotton Improved by Elucidation of Effect of Short Fibers.

Department scientists have conducted investigations which elucidate the effect of high short fiber content of cotton to show: short fibers adversely affect product quality in virtually all aspects, and drastically increase end breakage during spinning. As a result of this investigation, industry is making strenuous efforts to economically screen the cotton crop to control the short fiber content of their cotton mixes. Related research has been directed toward minimizing the effect of short fibers by selecting processing variables to reduce end breakage during spinning and improve product quality. This information is helping spinners obtain maximum spinning performance and yarn quality by using optimum spinning variables in conjunction with close control of short fiber content in their mixes. On the basis of this information, various mills have modified their blending procedures, placing the greatest emphasis on control of fiber length distribution. Information developed from the laboratory and mill scale tests indicates that spindle speeds can be increased considerably without increasing end breakage.

Stretch Cottons Expanding Cotton Markets. Twenty-nine mills are producing stretch cotton fabrics by the Department's slack mercerization process which is, so far as known, the only one in commercial use today. The potential market for these fabrics is estimated at 2410 million yards per year and a significant proportion of this will represent cotton use that would otherwise have gone to synthetics having stretch properties. Strong industrial interest is being shown in a newer Department-developed process which involves crimping resin-treated back twisted cotton yarns. This procedure yields a more stretchable cotton superior to that produced by slack mercerization for some uses.

New Wash-Wear Cotton Developments. Wash-wear fabrics continue to be one of the most exciting developments in the cotton industry, with current production in the United States estimated at 2 billion square yards annually. Industry estimates place the total market potential for wash-wear cotton fabrics at 4.5 billion square yards. Department research continues to strengthen the position of cotton in this field. For example, loss of strength in wash-wear cottons -- a serious problem ever since all-cotton wash-wear garments were introduced -- has been greatly minimized by a new technique of mercerizing and stretching the cotton yarn or fabric prior to application of wash-wear chemicals. In other research, Department scientists have developed a process that gives cotton wash-wear fabrics permanent luster and extraordinarily high tearing strength. Another new development involves a class of wash-wear agents called "carbamates". The overall performance characteristics of the carbamate finishes are considered to be better than those of most wash-wear finishes currently in use and at costs comparable to those of some present commercial finishes.

WURLAN-Treated Wool Yarn in Commercial Production. Three U. S. companies began this past year producing yarns treated with the ARS process for shrink-proofing wool fabrics. This "WURLANized" yarn is used for knit goods that combine the natural advantages of wool with the easy-care performance of synthetics, plus other desirable properties important to consumers. Producers claim that these yarns are "dependably washable by any normal method, truly resistant to shrinking and felting, more resistant to abrasion, have improved

tensile strength, retain the look and feel of wool, and exhibit no weight loss and no loss in chemical resistance." WURLAN-treated fabrics are being produced at a steadily increasing rate, which is now well over one million yards annually. The extension of the treatment to yarn greatly expands the application of the Department's discovery to a wide variety of knitted structures which otherwise could not be treated. The WURLAN treatment is thus playing an important role in improving the competitive position of wool through providing goods which are machine-washable.

New Dehydrated Vegetable Product Produced Commercially. The explosive puffing process developed by ARS engineers for preparing dehydrated vegetables capable of reconstitution in from one-fifth to one-tenth the usual time has been commercialized. A large manufacturer of dehydrated vegetables in California is now selling 3/8-inch carrot dice made by this new explosive puffing process. This product can be reconstituted by simmering for 5 minutes instead of the usual 40 minutes required for conventionally dried pieces of the same size. According to the manufacturer, "Recent evaluations of 'pilot runs' made in 1962 and production runs made in 1963 have shown that development of certain flavors and aromas that are characteristic of aging in conventionally dried carrots are greatly reduced in the 'Puffed Dried' (explosion puffed) carrots." Also, explosive puffing permits making larger dehydrated pieces than is feasible by conventional hot air drying. The process is extending the use of vegetables in dehydrated soups, stews and other products for civilian and military use.

Pure Culture Fermentation Process for Pickles. For the first time in history, a practical process has been developed to achieve pure culture, scientifically controlled fermentation of cucumbers and other vegetables. The research was motivated by major problems of the industry -- (a) to improve the curing process to avoid loss in value of cucumbers during traditional brine-curing and storing, and (b) to reduce the cost of processing. Controlled fermentation not only will reduce losses from softening and bloater activity but also will permit tailoring the flavor characteristics of the final product by selection of the type of cucumber and lactic-acid producing bacteria. Produced in a sealed container under highly sanitary conditions, the new product is not subject to the contamination that frequently occurs during brine-curing in vats. Pilot-scale tests of the pure culture continuous fermentation process (utilizing an inhibitor to prevent softening of cucumbers during brine-curing) are being conducted in cooperation with the North Carolina Agricultural Experiment Station, the National Pickle Packers' Association, and industry.

Better Frozen Fruits and Vegetables. While conventional freezing processes usually preserve the flavor, color, and nutritive value of frozen fruits and vegetables, they often have an adverse effect on texture. In common commercial practice freezing requires from 15 minutes to many hours. USDA scientists found that if freezing is accomplished very rapidly -- in a minute or less -- such damage does not occur. Green beans frozen by intermittent immersion in liquid nitrogen, for example, have a texture essentially the same as that of fresh beans. Freezing with liquid nitrogen is probably too costly

for all but high-valued products. However, other less expensive ways of achieving very rapid freezing are available and they will undoubtedly come into much wider use now that the improvement in product quality has been demonstrated. Retention of fresh-product texture in the processed product will expand the market for frozen fruits and vegetables.

Flavoring Constituent Identified in Grapefruit. Department scientists have discovered the identity of a constituent, nootkatone, in the essential oil of desert grapefruit which appears to be characteristic of the fresh fruit aroma. Nootkatone is present in good quality grapefruit oil to the extent of 0.3%, whereas poorer quality oils contain lesser amounts. It is present in small amounts in certain other citrus oils such as bergamot, lemon, lime, orange and tangerine. There are several potential applications of this discovery: (1) the nootkatone content of grapefruit oil may be used as an objective measure of its flavor quality; (2) addition of nootkatone to grapefruit products should prove to be a simple way to intensify the desired grapefruit aroma. Horticulturists and plant breeders should be able to use the nootkatone content to assess the value of new cultural practices and breeding studies on grapefruit flavor.

Linseed Oil for Curing Concrete. Based on results of cooperative work of the Department with the National Flaxseed Processors Association, linseed oil is finding a constantly increasing use for protecting cured concrete against freeze-thaw deterioration. Currently, research by Department scientists has shown that linseed oil emulsions have considerable promise for spray-type compounds to prevent moisture losses in the curing of concrete. In order to develop optimum strength properties, freshly laid concrete must be protected while curing against loss of water through surface evaporation. Presently this protection is obtained by solid coverings such as polyethylene sheeting or by spraying on an impervious surface coating. Research now underway indicates that the linseed oil applied to freshly laid concrete to aid in curing also acts as a freeze-thaw protective agent, thus giving a dual benefit from its use. The linseed oil is applied as a water emulsion using conventional road-spraying equipment. This development has a potentiality for a new multi-million-pound market for linseed oil.

Crambe, a Promising New Crop, Successfully Processed on Commercial Scale. Department research studies on processing crambe seed to oil and meal made possible a successful 40-ton commercial-plant run. Only minor equipment modifications in a conventional oilseed plant were required to obtain good recovery of oil and meal. Adequate supplies of crambe oil and meal products are now available for industrial evaluations, animal-feeding studies, and continuing Department investigations. Because of the favorable results achieved in this processing demonstration, an industrial company has decided to grow several hundred acres of crambe during the 1964 season. Crambe, a plant related to rape and mustard, can be grown in many parts of the country and appears especially suitable as a replacement for crops now in over-supply. Crambe oil would compete with imported rapeseed oil, but not with presently grown domestic vegetable oils. One of the immediate uses for crambe oil is to utilize the erucic acid, the principal fatty acid of crambe oil, in the manufacture of dibasic brassylic acid which already has several industrial end-uses.

New Diffusion Procedure Saves Beet Sugar. A new system for diffusion of sugar from beet cossettes has been developed by Department scientists which promises to increase the efficiency of sugar manufacture. In an effort to minimize stream and ground water pollution, beet sugar factories must return pulp press water to their diffusion batteries. It has been found that by adding the stream of pulp press water toward the head-end of the diffusion battery and the other make-up water at the tail-end, savings of the pulp press water sugar can be made. It has been estimated that 80% of the press water sugar can be saved, resulting in industry-wide savings of sugar worth \$4,800,000. Another application of these principles is in areas where saline well water is used for diffusion of beets. Efficiencies in processing can be enhanced by adding the well water at the tail-end of the diffusion battery and pure water toward the head-end. Savings of sugar, which would otherwise pass into molasses, due to excessive salts, is estimated to be up to \$50,000 per year for each of several American beet sugar factories.

New Peroxidic Product from Pine Gum Useful in Wide Variety of Applications. A new free-flowing, off-white solid peroxidic product with good industrial potential has been produced from crude pine gum by Department scientists. This low-cost material is made by chemically modifying the pine gum by a process known as photo-sensitized oxidation. Department research has shown that the pine gum peroxides are suitable for use in the polymerization of vinyl monomers, styrenated casting resins, gum rosin, ester gum and other industrial products. The plastics industry is expected to find the new peroxides highly useful as curing or vulcanizing agents in most products such as vinyl plastics, and casting and laminating resins used in plastic boats and construction panels. Applications in the plastics and rubber industries appear particularly promising, since the new peroxidic product should be considerably less expensive than most peroxides conventionally employed in these industries. The potential market for the new peroxidic products is estimated to be 12.4 million pounds valued at \$6.2 million for 1964, and 17.4 million pounds valued at \$8.7 million for 1969. Several companies are evaluating the new product and some of its derivatives in a variety of industrial applications.

Process Developed for Destroying Salmonella in Liquid Egg White. A process has been developed by Department scientists for stabilizing liquid egg white so that it can withstand pasteurization temperatures of 140-143° for 3½ minutes -- a condition necessary for destruction of Salmonella. Previously, adequate pasteurization was not possible because the necessary high temperatures cause coagulation of the egg white. The new process entails treatment of egg white with trace amounts of an edible aluminum salt to a concentration of 30 parts per million. Such stabilized pasteurized egg white yields angel cakes of volume and texture equivalent to those prepared with fresh eggs. Successful commercial runs with the new process have been made in two egg processing plants. Nearly 200 million pounds of egg white with a market value of about \$25 million are produced annually in the U. S. The development of this pasteurization treatment is an important step toward the elimination of Salmonellosis food poisoning outbreaks that can be attributed to egg products.

Radiation Preservation of Poultry Meat. Department scientists have defined processing factors that minimize deleterious changes in radiation-sterilized poultry meat. The research, supported by funds transferred from the Quartermaster Research and Engineering Command of the Department of Defense, demonstrated the importance of heating poultry to about 180°F. prior to irradiation. In addition to preventing enzymatic reactions resulting in off-flavor, this heat treatment eliminates an unattractive red discoloration which otherwise develops during storage of irradiated poultry. Additional improvement in flavor was accomplished by irradiation at subfreezing rather than ordinary temperatures. As a result of these and other findings, the QMC has concluded that radiation-sterilized poultry meat is a suitable product for feeding troops in locations where refrigeration is not available or economical.

New Method for Making Dried Whey in Commercial Use. The foam-spray method for drying cheese whey and other dairy products developed by ARS scientists is now being used by several large manufacturers of cottage cheese to make dry whey for food use. One large company alone can produce 3 million pounds of dry whey annually. The novel feature of the new process is injection of air into concentrated whey immediately before it enters the atomizer in the spray-drying chamber. The resulting dry product is free-flowing and disperses readily in contrast to dry whey produced by conventional spray-drying methods, which tends to be sticky and lumpy and does not reconstitute readily. Industry has found the new type drying equipment relatively inexpensive to install and operate. The entire cottage cheese industry has a potential to produce nearly a billion pounds of dry whey annually. Since most of the cottage cheese whey production has been disposed as a waste material because of lack of a profitable outlet for it, this development represents a large potential for increased income to the dairy industry, and at the same time it tends to alleviate the problem of stream pollution by dairy wastes.

Improved Low-Fat Ripened Cheese Developed. A new method for making low-fat ripened cheese, a product much desired by diet-conscious consumers, has been developed as a result of ARS research. Heretofore, skim milk cheese of quality suitable for direct consumption has not been available. While some cheese of this type is being produced by conventional methods, it is tough and lacks flavor and is used mostly for processing with other foods. The cheese produced by the new method is relatively soft, mellow, and mild flavored. While somewhat resembling Cheddar cheese, it has only about 5% butterfat in contrast to 31% for Cheddar and contains larger amounts of non-fat milk solids and moisture than Cheddar. The striking improvement in body, texture, and flavor has been accomplished through addition of selected monoglycerides to the skim milk and careful control of operating conditions during processing and curing of the cheese. The "new" cheese should satisfy a sizable consumer demand and provide an appreciable outlet for non-fat milk solids.

Biodegradable Detergents from Tallow. Recent investigations by ARS chemists indicate that detergents prepared from tallow are biodegradable. Included among the tallow-based detergents tested were the alpha-sulfo acids and their esters and tallow alcohol sulfates and their modifications. Activated sludge digestion tests have shown these to be more easily biodegradable than either branched-chain or linear alkyl benzenesulfonates (ABS and LAS). From companion ARS research, it is known that alpha-sulfo acids prepared from tallow are effective lime soap dispersing agents. For these reasons, such compounds may prove useful in soap-detergent combinations. This research also has shown that certain esters of the alpha-sulfo acids are especially effective as wetting agents. Since they compare in effectiveness with the best known commercial wetting agents and can be made very cheaply, commercial interest in them seems assured. Manufacture of alpha-sulfo acids and their esters is being undertaken by several commercial concerns. In the meantime, research is being done to develop more accurate means for evaluating biodegradability necessary as guides for development of detergents that are more easily biodegraded.

Discoloration of Potatoes. The tendency for the cut surfaces of potatoes to turn dark when exposed to air often lowers the quality of processed potato products, particularly prepeeled potatoes. Although darkening can be retarded by treating the tissue with sulfites, this may introduce an off-flavor that is objectionable to some people. Public Law 480-supported studies have shed new light on the phenomenon of darkening and suggest a new approach to solution of the problem. It was found that the major factor determining the rate of discoloration is the concentration of the compound, tyrosine, in the tuber and that the tyrosine level is largely influenced by the amount of water available to the growing plant and to a lesser extent by certain other cultural factors. Modification of irrigation schedules and other farming practices may yield potatoes much less susceptible to darkening. This will make possible the development of a consumer retail market for prepeeled potatoes, which until now have only been sold to institutional users because of their relatively short storage life.

New Catalyst for Preparing Chemicals from Soybean and Linseed Oils. A new oxidation catalyst has been prepared that offers the possibility of using air as a chemical reactant for the oxidative conversion of soybean and linseed oils into highly reactive, and potentially useful, chemical products without using hazardous and expensive chemicals. The new catalyst (which is an oil-soluble, organo-metallic compound) has been found effective in catalyzing the air oxidation of an unsaturated fatty acid to a new organic acid that has potential for producing new polymers for use in plastics and adhesives. Since air is used as the oxidizing chemical in this procedure, a process based thereon would appear to have the distinct economic advantage that the cost of the oxygen used would be that of the cost of pumping air through the oil. This research was conducted by Italian scientists under a P. L. 480 grant.

